LVIII. *Obſervations of the Tranſit of* Venus *over the* Sun, *on* June 3, 1769; *and the Eclipſe of the* Sun *the next Morning; made at* Eaſt Dereham, *in* Norfolk, *by the Rev.* Francis Wollaſton, *F. R. S. Extracted from ſome Letters addreſſed to the Rev.* Nevil Maſkelyne, *F. R. S. and Aſtronomer Royal.*

Read Dec. 21, 1769.

THE teleſcope I uſed was a reflector of Short's, of 12 inches focus, with a power that magnifies about 55 times. My clock was made by Holmes. It eſcapes dead ſeconds, has a pendulum with a wooden rod, and is firmly faſtened to a ſtack of chimnies in the room where I obſerve. I had lately received it from London, and regulated it by tranſits of the Sun and ſtars, taken with a tranſit inſtrument of a peculiar kind (deſcribed at the end of this account); and alſo by equal altitudes of the Sun, taken with another inſtrument of my own make. By ſeveral tranſits of the Sun and fixed ſtars, obſerved in the latter end of May and the beginning of June, I found I had brought it to go at the rate of mean ſolar time very nearly, *i. e.* loſing but 1″ in 14 days; and by tranſits of the Sun, it appeared to be 1″,5 too ſlow for mean time, on the third of June. But by a mean of

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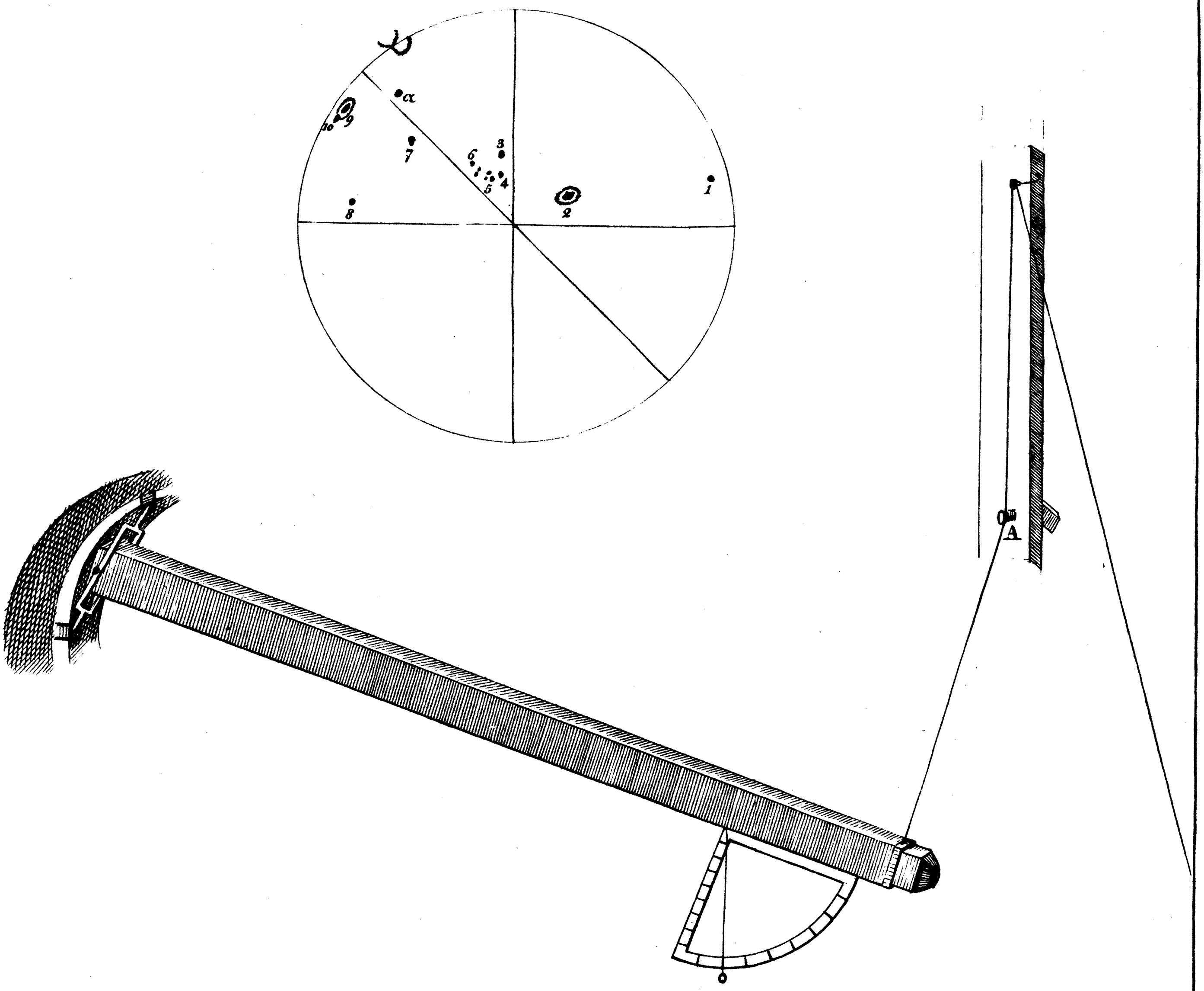
of 8 days obſervations of equal altitudes, taken in June and the beginning of July, the clock appeared 5″,2 ſlower than was found by the tranſit-teleſcope, which was not perfectly adjuſted; though, as its error continued always the ſame, it was very ſufficient for determining the rate of the going of the clock. Hence, on the day of the tranſit, the clock was 6″,7 or 7″ too ſlow for mean time; and the obſervations that follow are corrected accordingly.

In watching for the firſt contact of Venus, I kept my eye on the Sun's edge where the contact was expected; keeping that point nearly in the center of my field; and the firſt impreſſion which I ſaw (without any penumbra or atmoſphere that I could perceive) was at $7^h\ 12'\ 32''$ by my clock, or $7^h\ 12'\ 39''$ mean ſolar time. I looked particularly to ſee whether the reſt of the Planet were viſible while only part was on. If I ſaw that, it appeared as a portion of a larger circle: but I think I ſhould not have obſerved it at all, if I had not looked for it. The dark part on the Sun did not appear to me with a ſmooth edge; and yet I could not diſcern any undulation in it: but the clouds obliged me to ſlide my ſmoaked glaſſes ſo often, it interrupted me much. I then tried my ſtrongeſt magnifying power of 110, but to no purpoſe; for there was an undulation on the Sun's edge, by that time, ſo great, that I thought it beſt to return to the former power of 55. Before the internal contact, at about $7^h\ 24'$, I loſt the Sun entirely, and, though there were a few breaks in the clouds, he never appeared more that evening.

As to the eclipſe the next morning, I ſaw that more perfectly; though at firſt there were many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flying clouds; which, however, did not deprive me of any obſervation I was capable of making. It began here at $18^{h}\ 42'\ 17''$ by the clock, or $18^{h}\ 42'\ 24''$ mean time (a cloud had juſt paſſed; but I can be ſure it was not viſible $2''$ or $3''$ before); and it ended at $20^{h}\ 28'\ 1''$ by the clock, or $20^{h}\ 28'\ 8''$ mean time. I uſed the magnifying power 55, as I had done for the tranſit. As I have no micrometer, the beſt method I thought I could take to obſerve the phaſes of the eclipſe, was by the immerſions and emerſions of the ſpots; which, if there were comparative obſervations in other places, might meaſure them better than any inſtruments I have. The ſcheme annexed ſhews the ſituation of the ſpots, as I judged of them by my eye; and the obſervations that follow refer to the numbers in the drawing, TAB. XVII. fig. 1.

Mean time.

h	′	″	
18	42	24	Beginning of the eclipſe.
	44	37	Spot 1 immerges.
19	3	17	The nebula of ſpot 2 begins to immerge.
	4	47	Spot 2 quite immerged, but not the nebula.
	14	56	Spot 3 immerges.
	16	44	Spot 4 immerges.
	18	50	Spot 5 immerges,
	19	29	Spot 6 immerges.
	24	56	Spot 7 begins to immerge.
	25	22	Spot 7 immerges entirely.
	30	21::	Spot 1 immerges.

Mean time.

h	′	″	
19	33	50	Nebula of ſpot 9 begins to immerge.
	34	14	Spot 9 begins to immerge.
	34	51	Spot 9 immerges entirely.
	35	3	Spot 10 immerges.
	42	31	Spot 8 immerges.
	45	8	Nebula of ſpot 2 begins to emerge.
	45	52	Spot 2 emerges entirely.
	46	57	Nebula of ſpot 2 emerges entirely.
	59	22	Spot 4 emerges.
20	0	10	Spot 5 emerges.
	1	38	Spot 3 emerges.
	4	50	Spot 6 emerges.
	11	35	Spot 8 emerges.
	24	53	Spot 9 emerges.
	26	22	Spot 10 emerges.
	28	8	The eclipſe ends.

The ſpots α and N° 8 were not viſible (or overlooked) on the Saturday morning, when I took a drawing of the others; but I think I may be ſure were both ſeen that evening. The ſpot α certainly was not viſible the next morning, though N° 8 and all the reſt were: and, as far as I can recollect, that was its true ſituation. But, as the Sun did not break out till a few minutes before 7, and was quite gone before the internal contact, I had no opportunity to watch it. The roundneſs and blackneſs of that ſpot, at firſt ſuggeſted a ſuſpicion of its being a ſatellite of Venus: but as this is not corroborated by any other accounts, it is probably a miſtake. The two wires at right

right angles to each other, expreſs a horary circle, and a parallel of the equator (the teleſcope moving in the plane of the equator); and ſerve to ſhew the ſituation of the ſpots in general. The other is an oblique wire, the correſponding one having been taken out a few days before, in order to leave the field more clear.

As to my latitude, I have tried it different ways with ſuch inſtruments as I have; but what I truſted to moſt, were the zenith diſtances I took of α Cephei and α Cygni at one time; and η and ζ Urſæ Majoris at another (for ſome nights ſucceſſively) with my tranſit teleſcope; from which I ſuſpend a plummet, at a certain diſtance from the quadrant underneath, one of whoſe radii becomes thereby a tangent; which being graduated, I calculate by it the diſtance of ſtars near the zenith, and correct the errors of collimation by taking them both ways. I have likewiſe taken ſtars both ways, with my equal altitude quadrant, which indeed is a very imperfect inſtrument for that purpoſe: but, by calculating the mean, it turns out much the ſame as by the other method, viz. 52° 40′ 20″ north.

The other figure (2) is a ſketch of my tranſit-teleſcope, which you enquired after. The principle it goes upon is this: the center of the object-glaſs remains immoveable, while the teleſcope (by croſs-axes at right angles to each other, which interſect at that center) hangs as it were from thence, and has a free motion every way; and particularly its motion eaſt and weſt is freed, as much as poſſible, from friction. At the focus, where the croſs wires are, it is ſuſpended by a ſmooth even catgut, by which that end is let down to the altitude required. This catgut bears conſtantly againſt a deep angular groove that is cut round the end of the ſcrew marked A; by which means that end hangs always from the ſame point at all altitudes; from whence, the centre of gravity of the teleſcope keeps it conſtantly in the ſame plane. This ſcrew runs eaſt and weſt; and therefore, when the teleſcope is drawn up to a horizontal poſition, ſerves to adjuſt it to the meridian, by directing the wires to a diſtant mark. The ſettling of that meridian mark is certainly the ſame in this as in other tranſit-inſtruments; and perhaps mine is not exactly right. But I ſuſpect my inſtrument errs in another particular; that the line of collimation does not run parallel to the interſection of croſs axes and the center of gravity; which it ought to do. This is owing to bad workmanſhip, which a ſkilful operator could eaſily ſet right; and, when adjuſted, I ſhould think would not be apt to vary, but would always continue to deſcribe a true vertical, as indeed it has proved upon trial; having always, in this rude form, kept to the ſame errors at the ſame altitudes.

The reſt of the drawing, I believe, explains itſelf: excepting the two curved pieces of paſteboard between which the teleſcope is directed; which are deſigned to keep off the air that would make it vibrate; and do in effect take off alſo a great deal of falſe light in the day time, and anſwer the purpoſe of an illuminator at night.

The thought occurred to me while I was uſing Lord Charles Cavendiſh's meridian line; to which you ſee I thus adapt a teleſcope; and there being fewer particulars neceſſary to be attended to, when once rectified, I thought it would be more ſerviceable in a common building, than thoſe tranſit-inſtruments which require ſo very ſteady a foundation.

East-Dereham,
June and July, 1769.

Francis Wollaſton.